DESIGN AND FABRICATION OF ANTENNA TOWERS

PART 1 - GENERAL

1.1 SUMMARY

This specification sets forth the requirements for the design and fabrication of self supporting and guyed antenna support towers and associated foundations for an air to ground communication system.

1.2 REFERENCES

The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

FEDERAL SPECIFICATIONS

RR-5-001301 Safety Equipment, Climbing

RR-G-661 Grating –Bar Type

MILITARY SPECIFICATIONS

MIL-M-17194 Metal, Expanded, Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A-36	Carbon Structural Steel
A-53	Pipe, Steel Black and Hot Dipped, Zinc Coated , Welded and Seamless
A-123	Zinc (Hot Galvanized) Coatings on Iron and Steel Products
A-153	Zinc Coating (Hot Dip) on Iron and Steel Hardware
A-242	High Strength Low Alloy Structural Steel
A-307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A-325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A-385	Practice for Providing High Quality Zinc Coatings (Hot Dip)
A-490	Heat Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength
A-501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
A-615	Deformed Billet and Plain Billet Steel Bars for Concrete Reinforcement
A-618	Hot Formed Welded and Seamless High Strength, Low Alloy Steel Tubing

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)SPECIFICATION

Standard Practice for Steel Buildings and Bridges.

AMERICAN IRON AND STEEL INSTITUTE

Cold-Formed Steel Design Manual

AMERICAN WELDING SOCIETY WELDING HANDBOOK

D1.1 Structural Welding Code

ELECTRONIC INDUSTRIES ASSOCIATION

TIA-222-G Structural Standards for Steel Antenna Towers and Structural Supporting Structures

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

B18.22.1 Plain Washers

1.4 SUBMITTALS

1.4.1 Submittal Descriptions (SD)

Submittals are identified by SD numbers and titles as follows.

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

SD-03 Product Data

Catalog cuts and brochures illustrating size, physical appearance and other characteristics of equipment .

SD-05 Design Data

Calculations, analyses or other data pertaining to a part of work.

1.4.2 Variations

When proposing a variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government. If lower cost is a benefit, also include an estimate of the cost saving. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation. When delivering a variation for approval, Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.4.3 Format of Submittals

1.4.3.1 Transmittal

Transmit each submittal to office of approving authority.

1.4.3.2 Format for SD-02 Shop Drawings

a. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 by 42 inches.

b. Include on each drawing the drawing title, number, date, and revision numbers and dates.

c. Dimension drawings; Identify materials and products for work shown.

1.4.3.3 Format of SD-03 Product Data

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

1.4.3.4 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inches paper

1.4.5 Quantity of Submittals

Submit two copies of submittals for approval by the Contracting Officer.

1.4.6 Submittals Required

SD -02 Shop drawings

Tower design fabrication, foundation and erection drawings

SD -03 Product data

Safety Climbing Devices

SD - 05 Design Data

Tower structural design calculations

PART 2 - PRODUCTS

2.1 ANTENNA SUPPORT TOWER DESIGN

2.1.1 General

Each tower designed and furnished by the contractor shall be complete in accordance with all specification requirements including antenna supports, anchor bolts, safety T- rail and climbing device , protective grounding , and all hardware essential for the erection of the tower. The contractor shall provide all materials supplies, equipment and services necessary to design, fabricate and prepare for delivery of all items listed in the contract schedule.

2.1.2 Tower Description

2.1.2.1 Four Leg Tower

The tower shall be a self supporting or guyed steel structure with a platform at the top for mounting and servicing antennas. The tower shall be designed to be shipped knocked down and to be erected in the field using only structural bolts. The tower shall be fabricated in 20 foot plus or minus sections except that a 10 foot section shall be provided to obtain the required height(i.e. 30 or 50 feet) The tower members shall be fabricated from pipe, angular or solid stock. The tower shall have 4 legs.

2.1.2.2 Support Arms and Antenna Mounts

The antennas will be installed on 2 ½ inch OD pipes that extend 36 inches above the guard rail. The antenna support arms shall be spaced around the work platform to permit the installation of 6 antennas with 8 foot minimum separation. This can be accomplished with a square or rectangular platform with retractable antenna support arms in appropriate lengths and locations to provide the separation. The contractor shall submit designs for the antenna mount and its attachment to the tower.

2.1.2.3 Ladder

A ladder shall be mounted the full height of the tower and extend 4 feet above the work platform. An aluminum rigid T-Rail System shall be installed along the centerline of the ladder. The ladder and T-Rail System shall conform to OSHA standards including clearances.

2.1.2.4 Work Platform and Guard Rails

The platform shall be fabricated of angle framing members and the floor of the platform shall be fabricated from either expanded metal grating or bar type grating. The minimum area for the work platform shall be 42 square feet. The floor shall be secured to the framing. The platform shall be provided with a guard rail composed of vertical posts with a top and intermediate rail located 45 inches and 23 inches respectively above the platform floor. A 4 inch high by 12 gauge toe board shall be secured to the inside of the guard rail posts located ¼" above the floor of the platform. The toe board shall run continuously around the perimeter. The perimeter framing members shall support the rails, toe board as well as the required antenna mounting brackets.

2.1.2.5 Work Platform Access

Access to the tower shall be gained through a suitable trap door with a provision for being padlocked from the bottom. The weight of the trap door shall be 30 lbs or less. It shall be designed so that when opened by a climber, it shall remain fully open without being held by the climber. It shall be possible to fully open and close the trap door when ascending or descending the tower without disengaging from the safety climbing device. The minimum climbing clearances shall be 1'-3" on both sides of the ladder centerline and 2'-6" from the face of the ladder to the back of the opening. If the ladder is installed on the inside of the tower, then the bracing at the base shall be configured to allow for easy access to the inside of the tower.

2.1.2.6 Foundation

Two foundation designs shall be provided for the tower. One design shall be based on a safe soil bearing pressure of 2000 pounds per square foot and one on a safe soil bearing pressure of 4000 pounds per square foot. Concrete strength shall be based on a 28 day compressive strength of 3000 psi and a maximum slump of 4". Reinforcing steel shall be intermediate grade billet ASTM A-615 grade 60 deformed bars. Foundation designs shall be oriented toward economical construction based on the costs of labor and materials at the time of the design.

2.1.3 Special Requirements

Unless otherwise indicated EIA Standard TIA-222-G shall govern the design and fabrication of the towers. The design shall be in accordance with AISC and AISI specifications and established engineering practices.

2.1.4 Service Conditions

Towers with a work platform, six stacked UHF/VHF standard communications antennas located atop the structure, with 3ea – 4" PVC Schedule 40 conduits on one side shall sustain the maximum stresses imposed by the following ambient conditions without permanent deformation damage or degradation to operations.

Temperature	-50°C to 60°C
Wind load	TIA Standard RS-222-G Annex B for 100 mph or 150 mph Class – III Exposure - C Topographic Category - 1

Relative humidity	5% to 100%, including condensation
Environment	Salt spray Urban industrial fumes Wind borne sand and dust
Live Load	Platform 250 lb concentrated load over any one sq ft 20 lb/ sq ft Ladder 500 lb at any point on the ladder
FAA Equipment Wind Loads	Six communications antennas: projected area with .5 ice-2.3 sq ft. x 6 = 13.8 sq. ft. Junction box projected area – 6 sq. ft. 3 ea - 4 inch PVC conduits from the foundation to the tower platform 2 ea – ¾" lightning rod and down conductor mounted on a 2" diameter steel pipe extending 240 inches above the platform floor.
FAA Equipment Dead Loads	Six communications antennas: 18lb x 6 = 108lb Junction Box – 50lbs PVC Conduit - 1.98 lb/ft x 3ea = 5.94lb/ft of tower (braced by the tower and is supported by the foundation)

2.1.5 Design requirements

2.1.5.1 Work Required

The contractor shall submit structural design calculations and design fabrication, foundation and erection drawings. All design calculations shall be indexed and arranged in and orderly manner with appropriate sketches so that any element may be easily identified. Complete structural calculations are required covering all parts of the structures and all related items. Tower twist, sway and displacement shall be determined by analytical method. All design loads shall be identified; design methods and assumptions indicated. When computer printouts form a portion of the design calculations, the contractor shall include all input diagrams and information needed to relate the printout to the design elements. The computer programs utilized shall be identified and a brief description of each shall be included. The submittal shall be certified by a Registered Professional Engineer.

2.1.5.1 Tower Drawings

The drawings shall include plan and elevation views antenna mounts grounding system and any pertinent notes. Erection drawings shall indicate member location, bolt sizes and number ladder attachment with safety climbing device, antenna mounts and all other information to clearly depict required elements for field erection a parts list showing the member size and length shall be provided in the erection drawings shall be provided for the installation of the obstruction light system.

2.1.5.1 Foundations Drawings

The foundation drawings shall include both plan and elevation views. Drawings shall include reinforcing bar size, quantity and position anchor bolt size and position and other pertinent information for the constructing the foundations and anchors.

2.2 MATERIALS

2.2.1 General

Unless otherwise indicated materials shall conform to the specifications and other requirements below. Where no specification is indicated the materials shall be of a good commercial quality suitable for the government s intended use and shall be subject the approval of the CO the contractor shall furnish all materials and items required that the complete structure an in addition shall furnish nuts, bolts and washers and other minor items in an amount 10% in excess of the quantity required for erection.

2.2.2 Tower Legs

The tower legs shall be fabricated of steel pipe , structural angles or plates. Steel pipe shall have a minimum yield strength of 33,000 lbs per square inch per ASTM A-53 or ASTM A-501. Structural angles or plates shall have a minimum yield strength of 36,000 lbs per square inch per ASTM A-36. Legs fabricated from steel having a minimum yield strength of 50,000 shall conform to ASTM A-618 grade 3 for pipe and ASTM A-242 for angles or plates

2.2.3 Tower braces

The tower braces shall be have a minimum yield strength of 33,000 lbs per square inch per ASTM A-53 or ASTM A-501. Structural angles or plates shall have a minimum yield strength of 36,000 lbs per square inch per ASTM A-36.

2.2.4 Base Section

The base section of all self supporting towers shall be fixed base utilizing load bearing plates drilled to receive anchor bolts cast into the foundation or it may be a short section or integral part of the first tower increment. If a separate base section is used it shall be cast into the foundation and similar in construction to the other tower increments. Base sections of guyed towers may be fixed base as above or hinged base with a load bearing assembly cast into the foundation or attached with anchor bolts cast into the foundation. Anchor bolts shall be furnished with the tower.

2.2.5 Bolts, Nuts and Washers

Bolts, Nuts and Washers, High Strength - Shall conform to ASTM A-325 or A-490.

Bolts, Nuts and Washers, Other Than High Strength - Shall conform to ASTM A-307 Grade A

Plain Washers Other Than Those in Contact With High Strength Bolt Heads and Nuts - Shall conform to ANSI B-18.22.1 Plain Washers Type B

Locknuts.- A jam nut shall be used on each bolt beneath the full nut . Self locking nuts intended for use on exterior bolted connections with any associated lock washers may be substituted for approval as a substitute for the regular nut and jam nut.

2.2.6 Grating

Expanded Metal Type: Military Specification MIL-M-17194

Bar Type: Federal Specification RR-G-661

2.3 SAFETY CLIMBING DEVICES

An aluminum rigid T-Rail System conforming to RR-S-001301 and the following OSHA requirements:
(a) Absorb the impact load of 500 pounds. , 18-inch free fall.
(b) Support a minimum static load of 1,000 pounds.
(c) With lanyard, absorb the impact load of 250 pounds in a 6-foot free fall.

The system shall include the T-Rail, all mounting attachments and a stop for the top of the rail. Provide 2 safety sleeves with an instruction manual and parts list.

2.4 FABRICATION

2.4.1 General

Fabrication shall be in accordance with the AISC specification. Members shall not have sharp edges which would be hazardous during handling or other irregularities that would interfere with erection. Welding shall conform to the AWS structural welding code.

2.4.2 Stamping

Each separate member except bolts, washers, etc shall be clearly marked by stamping into the steel the part number shown on the drawings. All parts shall be marked in the same relative position. The mark shall be stamped in the steel before galvanizing and shall be clearly visible in the erected structure. Each piece shall be marked with one inch high letter/number combination.

2.5 FINISHES

Galvanizing – All ferrous parts shall be hot dipped galvanized after fabrication in conformance with ASTM A-123 and A-385. Hardware nuts bolts washers and other minor items shall be galvanized by the hot dip method in conformance with ASTM A-153 The projection portions of anchor bolts plus 12 inches shall be galvanized. The interior of all pipe shall be galvanized.

PART 3 EXECUTION

3.1 PREPARATION FOR DELIVERY

The complete system will be packed to insure carrier acceptance and safe delivery at the destination in containers complying with rules and regulations applicable to the mode of transportation

3.2 FIELD QUALITY CONTROL

Quality control shall be in accordance with the American Institute of Steel Construction Specification. All tests and inspections to determine compliance shall be made by the contractor and shall be subject to Government observation or verification. Contractor shall notify the CO five (5) days in advance of the delivery to allow a government representative to inspect the towers upon delivery.

3.3 REPLACEMENT OF DAMAGED OR MISSING PARTS.

Any damaged or missing parts noted at the time of the delivery inspection shall be replaced at no cost to the government. Parts damaged after the acceptance of the shipment shall, when requested, be replaced by the fabricator at a reasonable cost and time schedule.

End of Section

Notes to Buyer

The contents of this section are only for the information of the initiator of this procurement request and are not part of this specification. They are not contract requirements nor binding on either the Government or the Contractor. In order for these terms to become part of the resulting contract, they must be specifically incorporated into the schedule of the contract any reliance placed by the contactor on information in these subparagraphs is wholly at the contractors own risk.

Height

The height of the tower referred in the bidding documents shall be the height of the top guard rail of the platform above the top of the concrete footing plus or minus 2 feet

Typical Design

Attached Figures 1 -4 portray typical assemblies but are not requirements of this specification. These drawings are furnished only as a matter of information to the Contractor to assist him in visualizing a typical design. The Government does not represent or guarantee that conformance thereto will insure that the resulting product will meet the specification requirements. Any reliance which the Contractor places on the figure and drawings is wholly at his own risk and shall not relieve him of his contractual obligation to comply with all the requirements of this specification.

Safety Climbing Device

It is expected that the contractor shall furnish two Safety Climbing Devices for each site at which towers are delivered. Additional devices are not needed for additional towers delivered to the same site provided the rigid rail is of the same type and manufacturer.

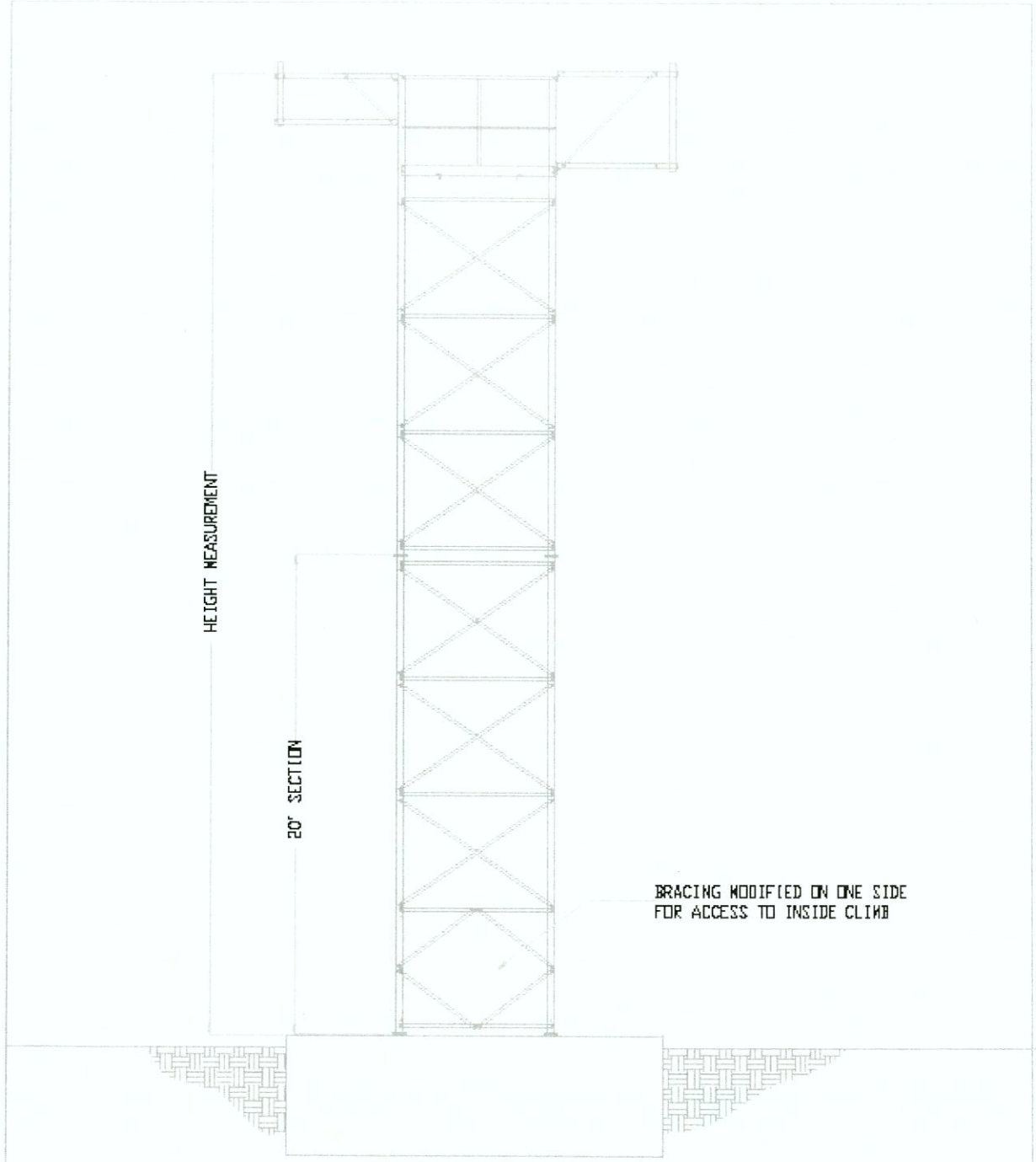

FIGURE 1 - SELF SUPPORTING TOWER

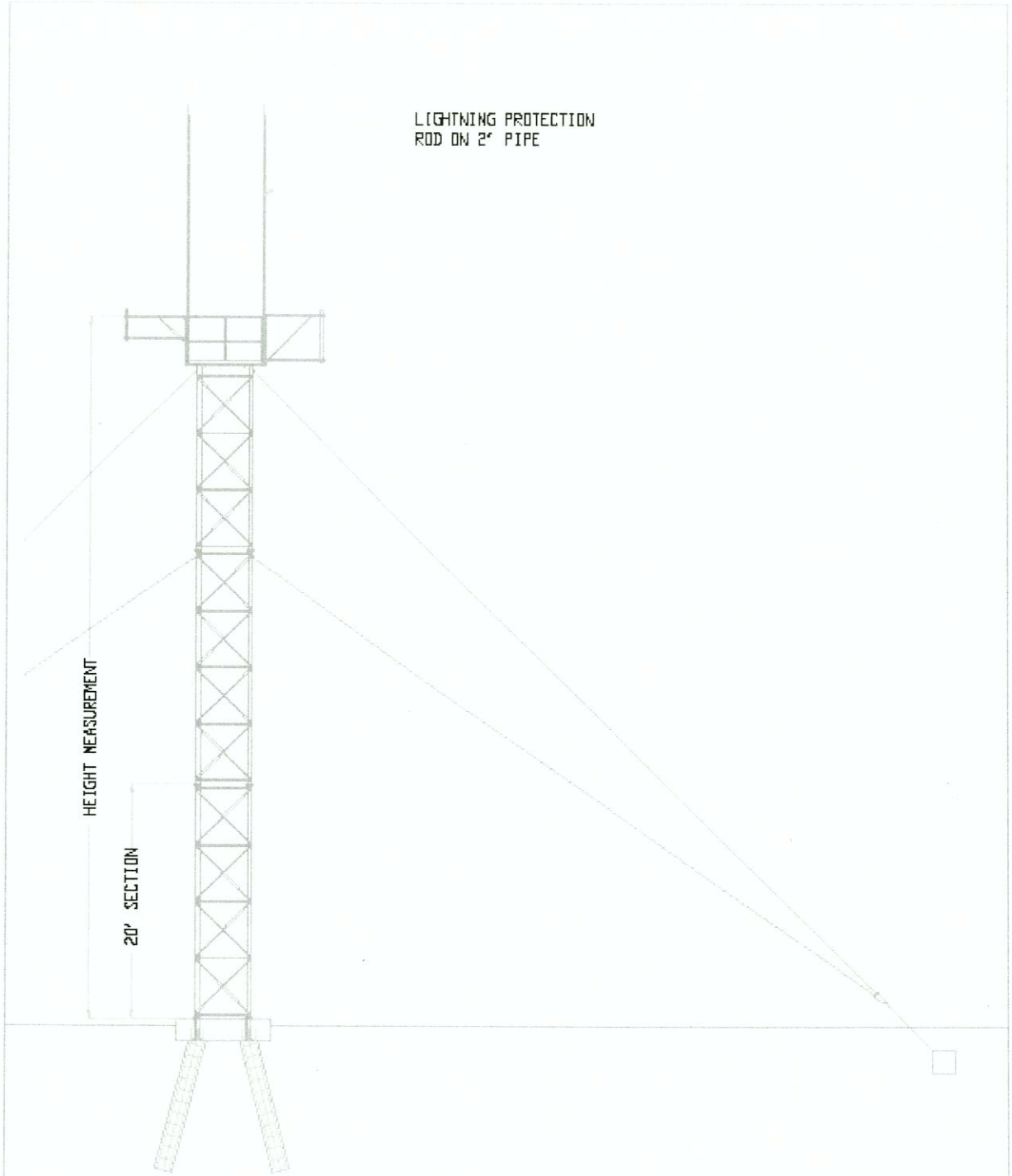

FIGURE 2 - GUYED TOWER

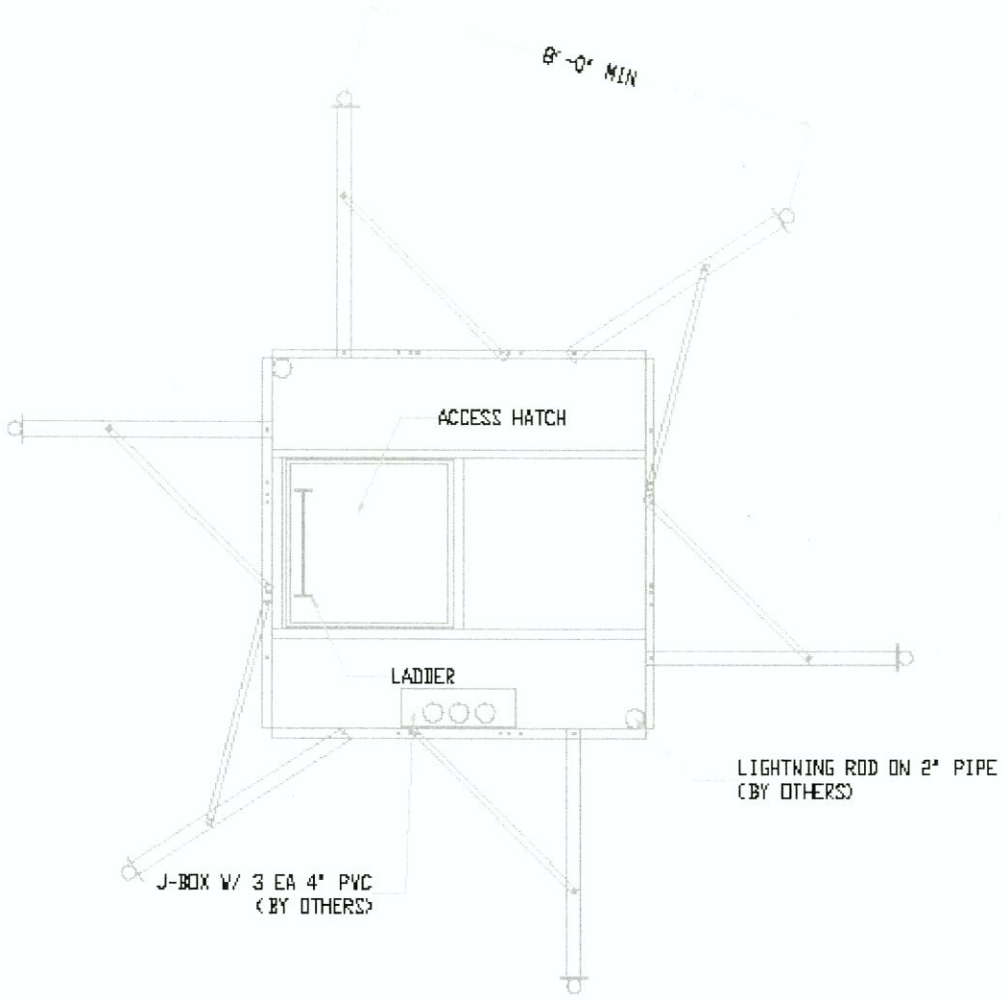

FIGURE 3 - WORK PLATFORM AND SWING ARMS

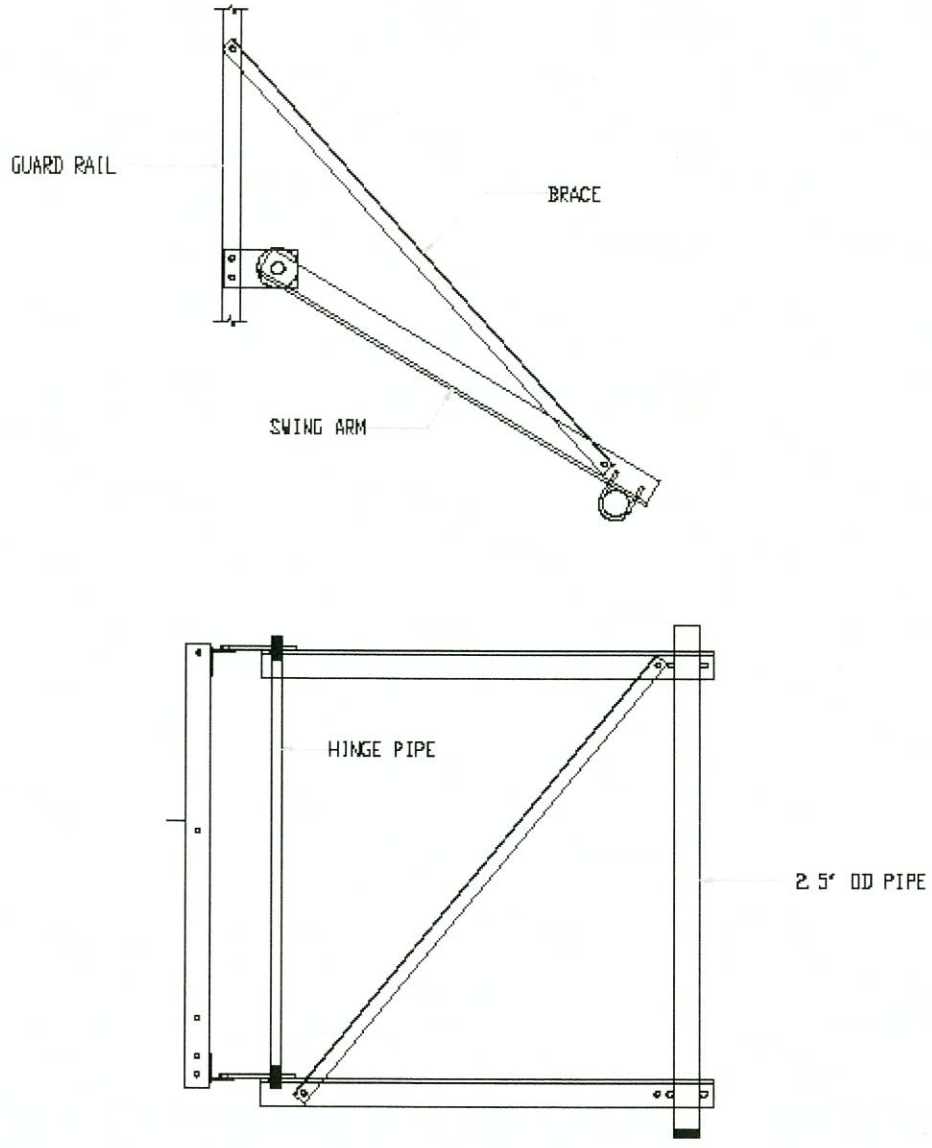

FIGURE 4 - SWING ARM DETAIL